

Appl. No. 10/579,799  
Amendment dated: August 2, 2010  
Reply to OA of: February 2, 2010

### **REMARKS**

Applicants have amended the specification and claims to more particularly define the invention taking into consideration the outstanding Official Action. Applicants note that claim 12 has been withdrawn from consideration as being directed to a non-elected invention/species and this claim has been provided with the proper claim identifier as withdrawn. The failure to include the corrected identifier in the previous response is regretted and the Examiner's courtesy in continuing the prosecution is appreciated. The claim identifier for claim 12 as withdrawn has been corrected.

Applicants also submit herewith an Information Disclosure Statement along with the payment of the required government fee.

Applicants have also amended the specification to provide for a brief description of the drawing as fully supported by Applicants' specification at page 14 and this meets the draftsman's requirements for the presence of a brief description of the drawing while the other heading would not be required by the draftsman in printing the allowed application. The use of the trademark Raney has been removed from the claims. Accordingly, it is most respectfully requested that the objection to the specification be withdrawn.

The rejection of claims 3, 5, and 31 under 35 U.S.C. 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention has been carefully considered but is most respectfully traversed in view of the amendments to the claims. As noted, the recitation of Raney metal in claim 5 has been deleted thereby obviating this aspect of the rejection. A description of the metal catalysts as fully supported by Applicants' specification has been added to claim 5.

Applicants have carefully reviewed the comments in the Official Action with respect to claim 3 as well as the contents of claim 3. Claim 3 actually says that the energy is used to power an electricity generator, i.e, the heat produced by burning

the hydrogen could be used to produce electricity. The effect of this claim is to specify that the heat or power consuming apparatus of claim 1 is an electricity generator. Accordingly, it is most respectfully requested that this aspect of the rejection be withdrawn. Finally, claim 31 has been deleted from the application and all the claims now present in the application are in full compliance with 35 U.S.C. 112, and are clearly patentable over the references of record.

The rejection of claims 1-4, 6-7, 13-17, 19, 28-33 and 35 under 35 U.S.C. 103 (a) is being unpatentable over US 4,435,376 to Porter et al in view of Mitsugi et al, Jin et al and Bannister et al and further in view of Baker et al has been carefully considered but is most respectfully traversed in view of the amendments to the claims and the following comments. In summary, the Porter reference does not teach one of ordinary skill in the art to conduct a process at a pressure of 3-6 bar as now specified in all of the amended claims and the teachings of the secondary references alone or in combination do not overcome this deficiency in the primary reference. Accordingly, each obviousness rejection is specifically traversed in view of the amendments to the claims.

Applicants most respectfully submit that the Porter reference, which forms the basis of the rejection for all of the claims, discloses a method for catalytic production of fibers carbon from hydrocarbons in which part of the carrier gas is replaced with a portion of the gas affluent from the pyrolysis reactor. The treated affluent, which is mostly methane, is thus reintroduced to be used as a carrier (column 2, lines 6-7). This does not appear to be relevant to the present invention, which provides a use for the hydrogen produced rather than recycling of unreactive hydrocarbon. Porter is silent regarding what happens to the hydrogen after it is removed from the affluent stream.

The presently claimed invention is one for converting hydrocarbon from wells into carbon, which is a more environmentally friendly product than the CO<sub>2</sub> which would be produced if the hydrocarbons were burned. The present invention therefore provides a method for avoiding CO<sub>2</sub> emissions by preventing CO<sub>2</sub>

production, as set out in the application as filed on page 1, lines 1-13 and page 2, lines 13-17. Moreover, by using the hydrogen produced to generate energy, further cost/energy savings can be made.

The method of the presently claimed invention requires that the hydrocarbon gas flow to the catalyst is at a pressure of 3-6 bar and applicants have surprisingly found the catalytic conversion of the hydrocarbon gas to carbon and hydrogen is more efficient at increased pressure than at atmospheric pressure. The plot below (which was present in the inventor's declaration filed in 10/514,238, shows the effect of pressure on carbon deposits expressed as hourly grams of carbon per gram of catalyst as a function of time and increase of yield from 7 grams of carbon per gram of catalyst to 86 grams of carbon per gram of catalyst was found when pressure was increased from 1 bar (blue plot, almost vertical line) to 5 bar (pink plot, sloping). The Porter document states that "generally pressures of 1 to 2 atm can be used", but is otherwise silent on the pressure level or importance of reaction pressure. There is thus no incentive in this document or any of the other prior art documents to use higher pressures in accordance with the amended claims now present in the application.

In fact, the generally accepted opinion in the field has been to use low pressures because this favours the reaction ( $\text{CH}_4 \rightarrow \text{C} + 2\text{H}_2$ ) thermodynamically. The highly efficient catalytic reaction which has been found at higher pressures by the Applicant allows the method of the invention to be applied on a large scale, e.g. to produce large quantities of carbon and hydrogen directly from hydrocarbon reservoirs.

Furthermore, the increased pressure reaction of the invention not only increases the yield of the reaction, but also facilitates the downstream hydrogen separation processes. Due to the increased efficiency, the method of the invention therefore not only prevents  $\text{CO}_2$  production, but leads to production of useful products (carbon and hydrogen) via a simpler process with reduced energy consumption and reduced costs. As using increased pressure in the

dehydrogenation reaction is not suggested in the prior art, but has been found by the Applicant to give surprisingly good results in the reduction of CO<sub>2</sub> emissions from gaseous hydrocarbon processing, the present invention cannot be considered obvious. It is therefore submitted that the amended claims are novel and unobvious over the references of record.

With respect to the rejections of claims 8 and 9, which further rely on the Wolff et al and Hsieh et al these secondary references do not overcome the deficiencies with the primary reference as discussed above and therefore it is most respectfully requested that these rejection be withdrawn. In connection with the rejection of claim 18, Applicants wish to note that the claim does not merely require that the gaseous hydrocarbon came from a well at some point, which seems to be the point raised in this rejection, and requires that the gaseous hydrocarbon comes directly from a hydrocarbon well to the catalyst. Again, the teachings of the secondary reference does not overcome the deficiencies in the primary reference as discussed above and therefore it is most respectfully requested that this rejection be withdrawn.

The rejection of claims 5, 7, 20-27 and 36 under 35 U.S.C. 103 as unpatentable over the combined references as discussed above and further in view of the patent to Schmidt and the article by Gao et al has been carefully considered but is most respectfully traversed for the reasons discussed above and the fact that the teachings of the secondary reference do not suggest the presently amended claimed subject matter, the results achieved by the amended process nor the deficiencies of the primary reference. Accordingly, it is most respectfully requested that this rejection be withdrawn.

The rejection of claim 34 under 35 U.S.C. 103 as being unpatentable over Porter et al and the secondary references and further in view of Oguru et al has been carefully considered but is most respectfully traversed in view of the above comments and further amendments to the claims. Again, the deficiencies of the primary reference for the reasons discussed above, and the results achieved by the presently claimed process, and that the teachings of the secondary reference do not

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overcome the deficiencies of the primary reference so that the rejection should be withdrawn.

In view of the above comments and further amendments to the specification and claims, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,

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